

E 115 120 125 130 135 140 145 150 155 160 E

N 45

TYPHOON GLADYS

BEST TRACK TC-14W

13 AUG- 24 AUG 91

MAX SFC WIND 65KT

MINIMUM SLP 973MB

LEGEND

- 6-HR BEST TRACK POSITION
- SPEED OF MOVEMENT (KT)
- INTENSITY (KT)
- POSITION AT XX/0000Z
- TROPICAL DISTURBANCE
- TROPICAL DEPRESSION
- TROPICAL STORM
- TYPHOON
- SUPER TYPHOON START
- SUPER TYPHOON END
- EXTRATROPICAL
- SUBTROPICAL
- DISSIPATING STAGE
- FIRST WARNING ISSUED
- LAST WARNING ISSUED

40

35

84

30

25

20

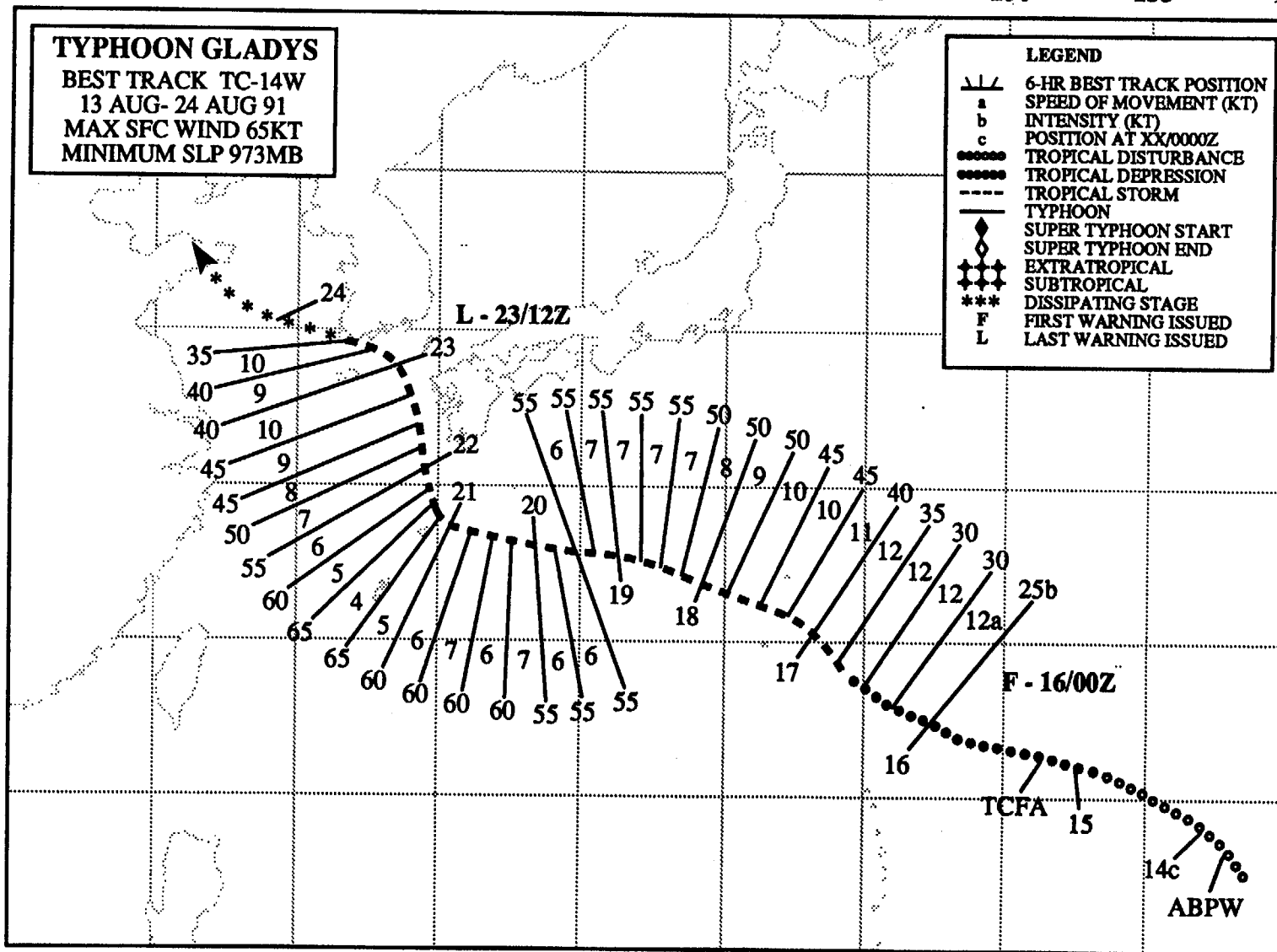
N 15

L - 23/12Z

F - 16/00Z

TCFA

ABPW



TYPHOON GLADYS (14W)

I. HIGHLIGHTS

Typhoon Gladys was the largest and the fourth of six tropical cyclones generated by a NSS monsoon gyre active during the month of August. While Gladys' wind field continued to expand as it tracked southwest of Japan, there was only a small change in minimum sea-level pressure, providing a good example of a cyclone that "strengthened" significantly but did not "intensify" significantly. Despite consistently outstanding track forecasts, JTWC over-forecast the cyclone's potential for intensification.

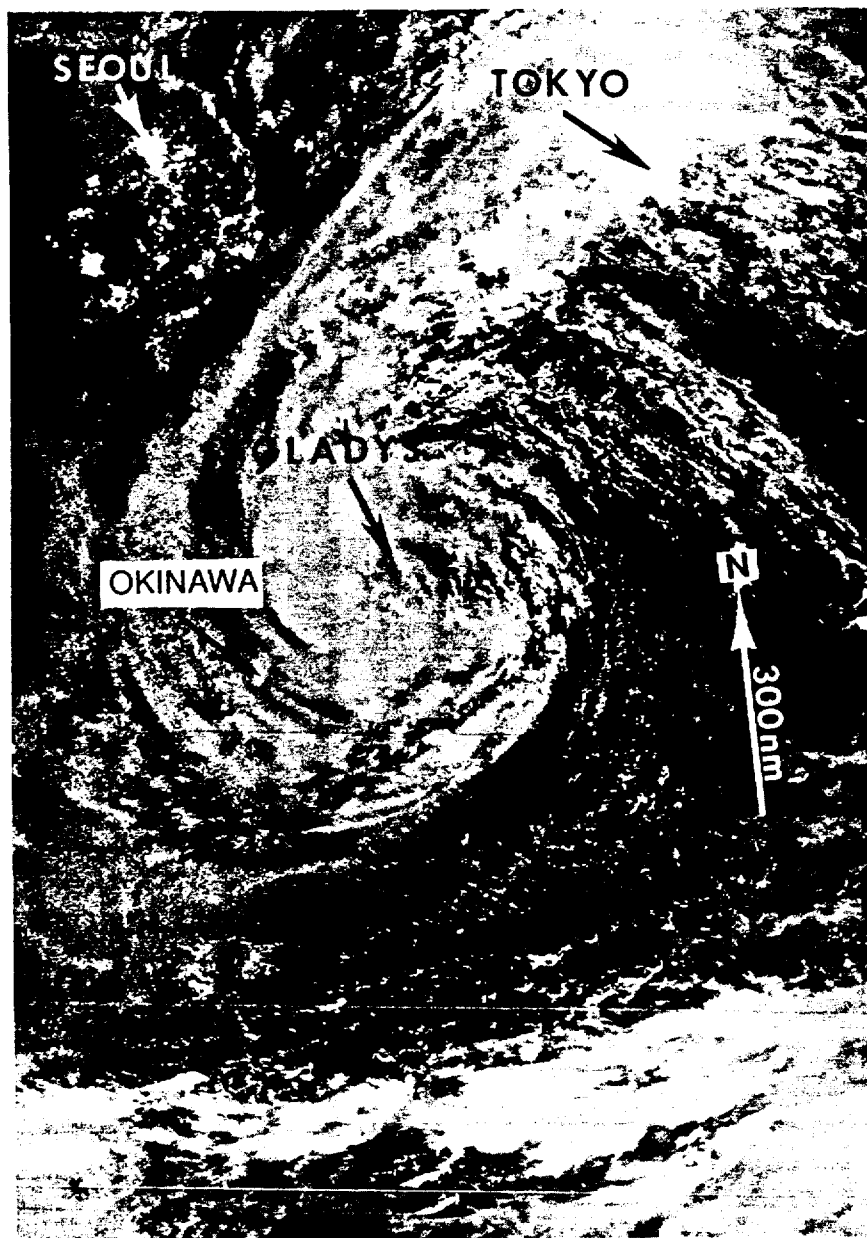


Figure 3-14-1. Tropical Storm Gladys approaches the northern Ryukyu Islands. At this time, land stations 360 nm (665 km) northeast of the center reported winds in excess of 35 kt (18 m/sec) (201235Z August DMSP moonlight visual imagery).

II. TRACK AND INTENSITY

Developing from an active NSS monsoon gyre in mid-August, Gladys tracked west-northwestward for most of its lifetime, south of an east-west oriented subtropical ridge. Initially described on the 131800Z Significant Tropical Weather Advisory as a weak cyclonic circulation, it slowly gained convective organization over the next two days, and a Tropical Cyclone Formation Alert was issued at 150730Z. The first warning (160000Z) on Tropical Depression 14W was based on increased curvature in the spiral convective bands. Then after receipt of several synoptic wind reports of 30 kt (15 m/sec), the cloud system was upgraded to a tropical storm at 161800Z.

The most distinctive characteristic of Gladys was its large size (Figure 3-14-1). Ships and island stations reported an increasingly large area of gale-force winds surrounding the poorly organized circulation. Because of its large size, it was hypothesized that beta drift added a northward component of motion to the westward-oriented track.

The effect of beta drift may have been demonstrated in the fact that Gladys tracked to the right of the dynamic forecast aid, OTCM (Figure 3-14-2). The large displacement of maximum winds far from the cyclone's broad center and the absence of deep convection may have prevented a normal rate of intensification (Weatherford, 1985). For most of its life, Gladys intensified at a slow rate of only 5 kt (3 m/sec) per day, reaching minimal typhoon intensity near Amami-shima, 90 nm (165 km) northeast of Okinawa. The weather station on Amami-shima (WMO 47909) recorded 64 kt (33 m/sec) gradient-level winds and a minimum sea-level pressure of 973 mb as the cyclone center passed within 35 nm (65 km) of the island. After clearing the northern Ryukyu Islands, a fast-moving mid-tropospheric trough induced Gladys to turn north-northwestward. As the trough passed, vertical shear increased on the poleward side of Gladys' cloud mass, and the central pressure of the system began to rise. Reestablishment of the mid-tropospheric subtropical ridge over the Sea of Japan on 22 August prevented recurvature, and Gladys tracked toward the southern coast of Korea. The final warning was issued at 231200Z when the combined effects of increasing shear and land interaction indicated that the circulation was weakening rapidly.

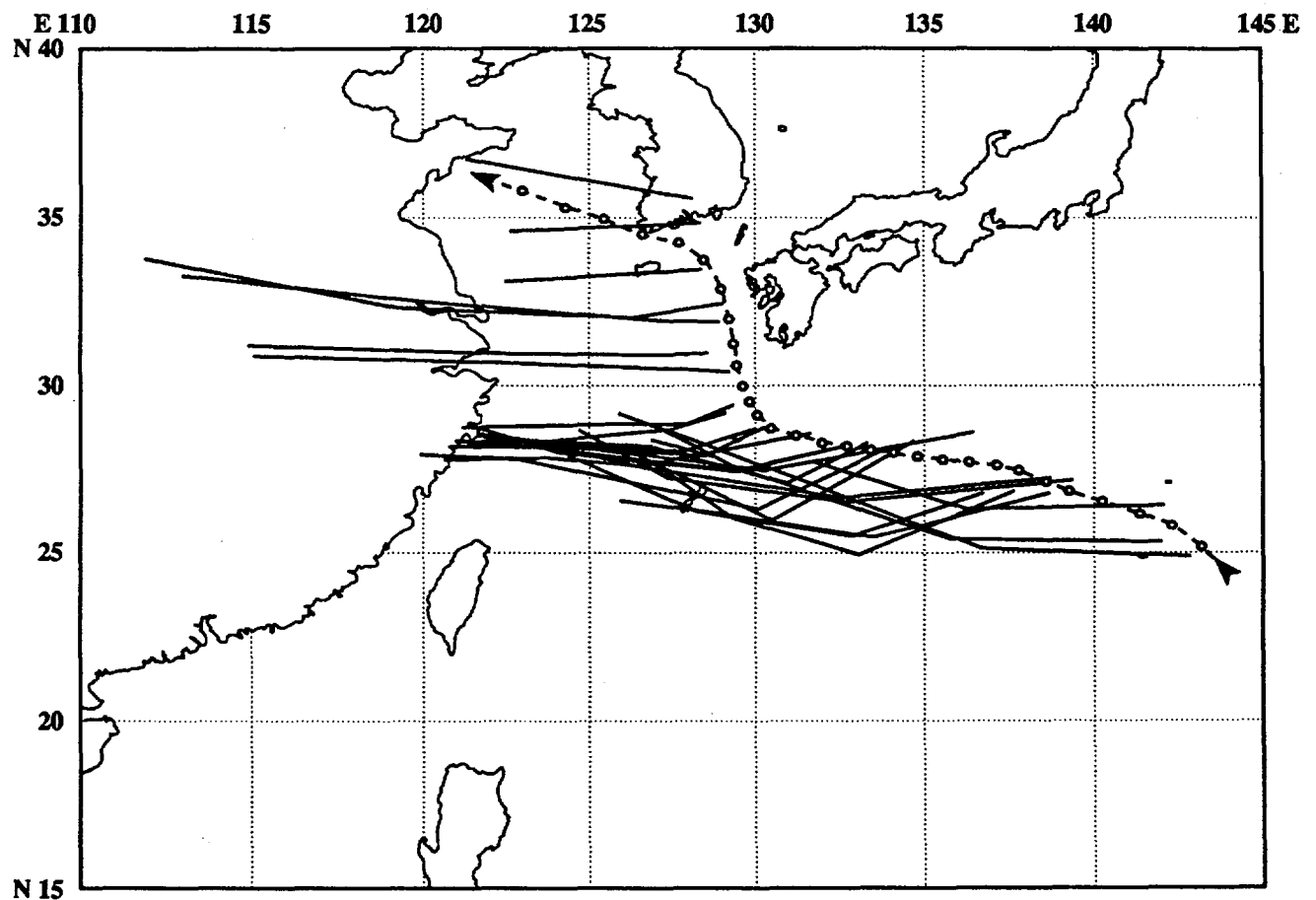


Figure 3-14-2. 160000Z to 231200Z August time series of One-Way (Interactive) Tropical Cyclone Model (OTCM) forecasts versus the official best track. OTCM's poor performance during the entire lifetime of Typhoon Gladys can be partially explained by the beta effect of large tropical cyclones.

III. FORECAST PERFORMANCE

JTWC motion forecasts of Typhoon Gladys were quite accurate; in fact, only one warning had 72-hour forecast errors larger than 300 nm (555 km). Of note is the fact that JTWC correctly predicted that the cyclone would not recurve, even as it turned north-northwestward near Kyushu. In contrast, other tropical cyclone warning centers in the region predicted that Gladys would recurve through the Korea Strait, between Tsushima and western Kyushu. The divergent forecasts increased the potential for conflicting information to reach operational decision makers in Korea and Japan. During this period, JTWC provided extensive, detailed prognostic reasoning messages which, in conjunction with the warning bulletins and telephone discussions, evaluated the potential for the possible forecast scenarios and helped allay operational concerns.

Intensity forecast performance was poor because Gladys was expected to reach a maximum intensity much greater than 65 kt (33 m/sec). At 161200Z, when the system was only a tropical depression, JTWC predicted it would rapidly intensify to a peak intensity of 120 kt (62 m/sec) in 72 hours, and for the next seven warnings peak winds in excess of 100 kt (51 m/sec) were forecast. As a result, wind errors for the duration of the forecast period were among the highest of the season. In post-analysis, most of the large wind errors could have been avoided if a simple equation relating latitude and peak intensity had been used (Mundell, 1990).

IV. IMPACT

Typhoon Gladys' huge circulation caused record amounts of rainfall in Korea and Japan. South Korea's Disaster Relief Center reported at least 90 people were killed or missing, 62 injured, and 40,000 left homeless. The center estimated property loss at nearly US \$45 million. Pusan, Korea's second largest city, received 24 inches (610 mm) of rain in 20 hours and sections along the southeast coast were reported to have received 26 inches (660 mm) during the same period. In addition, Gladys dumped as much as 28 inches (710 mm) of rain on central Japan, triggering landslides which killed 10 people west of Tokyo and flooded at least 1,000 homes.